AQUACULTURE SITING ISSUES IN WASHINGTON'S COASTAL ZONE

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Coastal Resources Program
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PREFACE

Conflicts between important uses of the coastal zone are growing. Greater commitments of aquatic resources are required as aquaculture activities expand and intensify. At the same time, increasing recreational and residential use of the coast are placing other demands on many of the same resources. Nearshore residents want to protect recreational opportunities and the scenic qualities of the shore. To protect their livelihoods, aquaculturists, including oyster growers, clam harvesters, and salmon farmers, also need space in aquatic areas and assurance that other uses will not degrade water quality or destroy their structures. In Washington State recent public debates are documented which surrounded the mechanical harvest of clams, raft culture of mussels, and pen rearing of salmon. Subjects of potential conflict are shown in the questions of continuing the subtidal harvest of geoducks, raft culturing of marine algae for food and chemical extracts, and continuing the use of public nearshore aquatic areas for private oyster farming.

The resolution of these conflicts is extremely important. Decisions made by public agencies and the precedents these decisions set will impact the balance of uses in the coastal zone, the vitality of the aquaculture industry, and the maintenance of the environmental and aesthetic qualities of the coastal zone. At present no state policy exists which adequately deals with these problems. Public agency review and action can be confusing and contradictory because jurisdiction is distributed among a number of federal, state, and local agencies with diverse constituencies and contrasting mandates.

Identifying suitable sites for aquaculture is a complex task. Technical needs of the industry limit operations to sites with specific physical, biological, and chemical characteristics. Calm waters free from destructive waves and currents; high water quality unpolluted by domestic sewage, agricultural runoff, and industrial pollutants; and habitat conditions required for survival and growth of the target organisms are necessities for the success of many types of aquaculture. Additional factors also must be considered in order to protect the overall public interest. Competition and compatibility with other uses of the coastal zone and the impacts on the environmental and aesthetic qualities of the area require the evaluation of government agencies and private individuals.

The difficulties in deciding <u>what</u> decisions to make, <u>how</u> to make them, and <u>who</u> should make them result in delay, uncertainty, inefficiency, and ineffectiveness. Disputes arise and conflicts can intensify. Resources can be lost or wasted while fledgling aquaculture industries have few opportunities or incentives to develop.

This report provides background information on these issues and suggests that the following aspects deserve more attention in the future: (1) how environmental impacts and risks are determined, (2) how claims for aesthetic quality can be evaluated and measured, (3) how the agencies can better coordinate their policies for coastal area use, and (4) what methods can be used to plan for the aquatic areas which recognize the special features of the aquatic areas.

Local planners and county commissioner will find this report useful for making site specific decisions and for refining and implementing the shoreline master programs. State resource or regulatory agencies and lawmakers can use this report in their efforts to explore avenues for administrative and legislative reform. Marine scientists may find the issues presented helpful in designing relevant research programs. The aquaculture industry and the interested public can use this paper as a guide to the scope of the difficulties and a reference source for further information and discussion.

Aquaculture Siting Issues in Washington's Coastal Zone is intended to stimulate the thoughtful examination of the many aspects of the problem. The report urges the directed search for solutions which will provide for the wise use of coastal resources, protect the integrity and value of coastal ecosystems, and lead to a more rational system for managing the many competing uses of the coastal zone.

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INTRODUCTION

The natural, quiet beauty of the rural shores of Puget Sound attracts those who would build second homes, retire from the urban work world, or simply spend their leisure time relaxing or recreating. The nutrient-rich, unpolluted and protected inland marine waters of the Sound also provide opportunities for the culture and harvest of desirable food fish and shellfish. In general, most people would probably agree that both residential use and aquaculture* are "good" uses of the coastal zone; uses to allow and encourage. Increasingly in specific coastal areas agreement vanishes as supporters of one resource use see the other as a threat.

As an example, recent testimony by concerned citizens before the Kitsap County Board of Commissioners claimed that the hydraulic harvesting of subtidal hardshell clams:

A. destroys subtidal aquatic environments and associated plants and animals;
B. causes extraordinary amounts of broken clam shells to be washed up on nearby beaches;
C. results in unacceptably high levels of turbidity (amount of suspended solid materials in the water);
D. is unacceptably noisy and interferes with the residential character of the area; and
E. is ineffectively monitored by the Washington State Department of Fisheries.

In response to concerns of the local citizens, the Washington State Departments of Fisheries and Natural Resources contend that subtidal mechanical hardshell clam harvesting in the site being discussed:

A. is being managed under criteria which insure that no more than negligible disruptions occur to natural systems and that no lasting negative effects result;
B. cannot be shown to cause an increase in beached broken clam shells above naturally fluctuating levels;
C. does not cause a significant increase in turbidity;
D. complies with appropriate noise standards; and
E. can be regulated effectively by the Department of Fisheries.

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* Aquaculture, for the purposes of this article, is defined to include all activities which involve the cultivation or raising of marine plants and animals, plus the harvest of bottom dwelling wild stocks (e.g., kelp, mussels, hardshell clams, oysters). These activities are considered jointly because of their very similar management needs and difficulties.

Some professional aquaculturists conclude that subtidal mechanical hardshell harvesting:

A. is not deleterious to the environment when practiced properly;
B. is a legitimate use of a renewable resource which would otherwise be wasted;
C. actually increases the productivity of clam beds, and has been practiced for long enough on the Atlantic coast that the biological principles which have been established there can and should be transferred to the decision-making process in Puget Sound; and
D. helps satisfy consumer demands for shellfish.

Subtidal harvesting of hardshell clams is only one example of a growing controversy over aquacultural use of aquatic areas. Conflict has also developed over the siting and development of mussel rafting operations in Island and San Juan Counties, oyster farming in Pierce County and Hood Canal, and pen rearing of salmon in South Puget Sound. If the technology is available and market conditions are favorable, the culture of marine algae for food or chemical extracts may present future conflict situations. The development of the aquaculture potential of aquatic areas and the maintenance of a balance of uses of these areas depend on decisions by state and local governments.

Examination of aquaculture siting decisions in the past clearly indicates that the future of aquaculture does not depend solely on technological or economic considerations. In each aquaculture siting decision, the decision-makers are required to determine the extent of environmental impact and the level of acceptable risk, the significance of changes in the aesthetic qualities of the environment, and the importance of precedents which may be set by a decision. In each case possible trade-offs must be identified and weighed and often the information on which to base decisions must be gathered anew.

The decision process must consider the long-term public interest which is to be advanced or protected and whether the interests of a broad statewide public or only the interests of the immediately involved public are to be served. Aquaculture development and site suitability decisions are no exceptions to the perennial dilemmas in public policy of defining the public interest and determining who determines the public good. As is the case for other public policy problems, the answers to aquaculture siting questions are neither easy nor apparent.

One set of definitions of the public interest arises from state law and administrative policy. The use of publicly-owned renewable resources and the leasing of public land for the overall benefit of the state is a clearly recognized priority of the Washington Shoreline Management Act of 1971 (RCW 90.58) and is a mandate of both the Washington State Department of Fisheries and the Department of Natural Resources. (For a brief description of the legal framework for aquaculture management see Appendix A). The legislative mandate to the Department of Fisheries (WDF) requires

the agency to manage the use of living aquatic resources in order to avoid waste of these resources and to protect the environment (RCW 75). With regards to aquaculture WDF policy is, therefore, to encourage the development and practice of economically and environmentally viable commercial activities. Shellfish experts at WDF also reason that the existence of a productive aquaculture activity in an area will reinforce arguments to protect water quality by actually establishing an economic reason for maintaining high water quality. Supporters of aquaculture believe that the requirement for high water quality makes aquaculture compatible with a number of other important and beneficial industries and uses.

The administrative policy of the Department of Natural Resources (DNR) gives preference to allowing renewable resource activities in state-managed aquatic areas. The leasing of state tidelands and beds of navigable waters for specific uses is defined to be in the public interest if these areas are protected from competing uses which would conflict with commercial aquaculture and fishing. For specific aquaculture activities or structures, any interference with navigation must be minimized and the visual impacts must be controlled. DNR considers the funds produced from the lease fees as compensation for reduction in availability of public lands, as alleviations to the general tax burden, and as compensation for any environmental impact linked to the private use of public resources (1).

Residents and owners of land upland of potential aquaculture sites often define the public interest differently. A great deal of the opposition to activities such as mechanical clam harvesting or to raft culture of mussels is based on sincere concerns that private aquaculture and resource harvesting threaten the environmental and aesthetic quality of an area and will harm public rights and resources (2).

The history of decisions by the Washington State Shorelines Hearing Board (SHB) establishes the paramount importance of the public interest in development of shoreline management priorities (3). But the SHB has not specifically addressed the broad public interest questions regarding aquaculture development as it affects the aesthetic values of the on-site upland owners and shore users.

The difficulties of deciding <u>what</u> choices to make are further complicated by trying to identify <u>who</u> should make them and <u>how</u> the decisions are to be made. Debate over who and how aquaculture policy questions are to be decided tends to follow the lines of state versus local authority and in the end challenges the concept of government coordination and balanced multiple use which are found in the Washington Shoreline Management Act. The existing decision-making system for aquaculture use of aquatic areas seems to be characterized by overlapping responsibilities of different governmental units, lack of coordination between and among these units, lack of experience in planning for aquatic areas, and difficulties in the transfer of experiences from one instance to another. The seriousness of these difficulties in decision-making should not be understated.

Supporters of aquaculture fear that unless these difficulties are resolved, all opportunities for aquaculture development in Puget Sound will eventually be lost and the industry will die. Administrative and management issues may, in fact, be more important in determining the future of aquaculture than biological or technical questions such as preventing the spread of disease or providing the proper growing conditions.

The economic value of aquaculture in Washington State is somewhat difficult to ascertain. Data is sometimes difficult to collect and to sort into separate industries. Very little recent work has been done on the economic valuation to the state and economic potentials remain speculative. The most recent (1976) Washington State Department of Fisheries statistics on the economic value of aquaculture show that the value of the product to the aquaculturist before processing is about $425,000 for hard and soft shell clams, $940,000 for geoducks, and $8,000,000 for oysters. Values for pen reared salmon are difficult to obtain, but based on rough data the 1976 value to the fisherman was about $400,000. Maturation of the pen reared salmon industry is estimated by WDF to have increased this value ten to 20 times by 1979. The most recent calculation of the net addition to state incomes from saltwater fisheries was compiled for 1965 and 1966 (4). Separation of aquaculture activities from commercial fishing operations and extrapolation to the present is difficult, but some general observations are possible. First, the products are largely shipped out of state and there are only minor imports of goods and services into the state to support the industry. Therefore, a net inflow of money payments to Washington residents is expected to be substantial. Second, in 1965 and 1966 every dollar to fishermen from the sale of their harvest resulted in a net addition of $2.30 to the residents of the state. These figures are averages and include salmon and other commercial fishing plus aquaculture. An up-to-date input-output analysis would be necessary to accurately evaluate the benefits of aquaculture to the economy of the State of Washington.

The purpose of this report is to identify the key problems of aquatic area management for aquaculture in Washington State and to identify the initial steps being taken to deal with these problems. Experiences in mechanical clam harvesting, mussel rafting, and oyster farming are used as illustrations. It is hoped that this report will serve as a point of departure for discussion among all interested citizens, within and outside of government, on the important issues surrounding aquatic area use policies. This report can be an initial effort on which state and local governments can base studies and test solutions in the search to provide the "coordinated planning ... necessary ... to protect the public interest associated with the shorelines of the State, while at the same time recognizing and protecting private property rights consistent with public interest." (Introduction to Final Guidelines, Shoreline Management Act of 1971, WAC 173-16.)

DETERMINING ENVIRONMENTAL IMPACTS AND RISKS

Beginning with the National Environmental Policy Act, environmental impact statements, alternatives analysis, and interdisciplinary approaches which insure the use of environmental information have become a real part of public decision-making. But obtaining the goals of NEPA has often proved difficult. The lack of information and the difficulties of actually utilizing available information, the troubles of identifying probable environmental impacts before the fact, and the near intractability of quantifying and evaluating risks associated with a project are common problems. (5)

Aquaculture siting decisions are not exempt from these difficulties and they are frequently further complicated by the experimental nature of aquaculture and limited local experience. Some scientists consider aquaculture siting decisions to be as chancy as drawing straws from a black box because little information exists about such issues as the effects of aquaculture projects on water quality, primary productivity and the dynamic relationships among biological communities.

One possible approach to aquaculture siting in the absence of specific resource use and impact information is suggested by a recent action in San Juan County (6). The County Commissioners received an application for a permit to allow commercial production of oysters on subsurface grow-out racks and production of clams on a beach to which the developer would add gravel. Residents of nearby upland areas expressed concern about possible water quality degradation and adverse changes in the naturally occurring biological communities. The County Commissioners decided that insufficient information was available to develop an environmental impact statement; however, they issued a conditional permit for a pilot effort. In doing so, the county took advantage of a special and unique resource: the University of Washington Friday Harbor Marine Laboratories located a few miles from the proposed aquaculture site. The county and the developer contracted with the laboratory to establish an on-going biological monitoring program that would detect and document the emergence of any effects of the project, adverse or otherwise. It was agreed that the aquaculture project would be terminated if the monitoring program suggested any likelihood of irreversible or unacceptable environmental change.

Monitoring a pilot program can provide needed information in some site specific cases, but such approaches are not always available. For instance, in the case of mechanical clam harvesting (for a description of mechanical clam harvesting see Appendix B), the issues are not confined to a single specific area nor even to the boundaries of one county. There has been a significant public outcry about the possible impacts of these harvestors. As a result, resource managers recognize the need for broad solutions that can be applied statewide. The Washington State Departments of Natural Resources and Fisheries (DNR and WDF) refused new permits and

stopped leasing of harvesting tracts while a programmatic environmental impact statement was drafted and reviewed. To prepare this EIS, DNR and WDF secured background information from several sources. Some literature exists describing the environmental impact of mechanical clam harvesting elsewhere in the country (7). Much of this information can be applied only generally to the specific cases in Washington because of differences in target species, bottom sediments, current and wave regimes, and associated biota. Locally, the Washington Sea Grant Program has published information on the mechanical harvest of soft shell clams (8) and the University of Washington has provided results of research on specific Puget Sound habitats (9). However, WDF must rely primarily on its own hard shell clam survey data (10) and studies of a few local lease tracts which have been mechanically harvested (11). Opponents of mechanical clam harvesting have questioned whether as promoters, regulators, and monitors, the WDF and DNR can prepare an unbiased environmental impact statement. The WDF replies that they have the professional expertise and experience necessary to identify and analyze the impacts. The Final Environmental Impact Statement for the Commercial Harvesting of Subtidal Hard Shell Clams With a Hydraulic Escalator Shellfish Harvestor (12) is now available to concerned parties who are trying to find a way to resolve their differences.

In addition to the problems of lack of information and perceived bias, the high costs of providing environmental impact information for conflict resolution must also be considered. Shellfish experts in WDF ask whether it is important to the public that the costs of the surveys and experiments required to resolve the mechanical clam harvesting issues exceed the revenue value of the harvested clams (13). Further, the high costs of ecological research can also exceed the potential direct income to the state from lease and license fees which tend to be set at a level which encourages beginning aquaculture ventures. Shellfish biologists in WDF ask whether the current level of political pressure surrounding a particular resource use should be a major criterion to determine the focus of WDF research and data gathering. Allocation of state agency research efforts for the study specific, and perhaps limited, conflicts forecloses other research opportunities which, in the long run, may prove more important to the maintenance of environmental quality and the living resource-based industries.

Finally there is a question of risks accompanying an action. Environmental risk analysis involves identifying the probability that an impact will harm the biological and human environment and weighing this probability against the magnitude of the possible impacts (14). Risk analyses are extremely difficult to determine (15). Furthermore, the levels of risk which are socially and environmentally acceptable are problems which are easier to name than to define or quantify. EISs do not address these issues in a clear-cut manner, yet the questions of risk and acceptable levels of risk are a critical component of public decision-making for aquaculture siting. EISs do not, but resource managers must, answer questions like: What is the risk that a unique habitat and the organisms it supports will be destroyed? What is the risk that job

opportunities will be lost? What level of environmental risk can we tolerate in order to provide seafood to consumers?

The aquaculture industry also must deal with questions of risk. In addition to site availability and acceptance by upland residents, the selection of sites by an aquaculture developer is based on the best assessments of suitable chemical and physical environmental characteristics. High water quality and protection from potentially destructive waves or tidal currents are important criteria. If an error is made in site selection or if environmental conditions change, the aquaculturists risk their entire investment. As an example, an oyster hatchery was located on Liberty Bay in Kitsap County. The hatchery was the only facility in the state which actually produced oyster larvae and raised oyster seed ("spat"). Some natural settling of oyster spat occurs irregularly in one area of Puget Sound. Otherwise, spat for oyster farms is imported from Japan. After several years of hatchery operation, the hatching oyster larvae began to die. Investigations suggested that low levels of toxic chemicals introduced into the water either from agricultural runoff, domestic sewage, or a nearby electroplating facility were killing the larvae. The hatchery was forced to close and the State lost a new and potentially important industry.

VALUING AESTHETICS

Changes in the aesthetic qualities of the environment due to resource use has become a significant issue. Increasingly, the courts are recognizing the responsibility and power of legislative bodies to protect aesthetic interests. But defining aesthetic values is difficult. Opportunities for abuse via arbitrariness and elitism exist (16).

Upland residents in areas of proposed aquaculture projects are often concerned that the scenic qualities of shoreline areas will be disrupted or that their activities will be disturbed by noises or odors associated with these projects. Some observers of mechanical clam harvesting in Puget Sound have concluded that the crux of this issue is not that of ecological impacts, but is one of impacts on aesthetic values. Upland residents are objecting to the sight and sound of the offshore mechanical clam harvester.

Objectively analyzing aesthetics may be difficult, but it is possible to compare proposed projects with other, acceptable activities or to determine the compliance of the projects with established regulations.

Perhaps, argument by analogy can provide a perspective on mechanical clam harvesting questions. Commercial fishing boats are viewed by many as interesting and positive additions to marine scenes. Yet the potential for overfishing and environmental damage are well known. Would a positive aesthetic value placed on fishing boats and a negative one on mechanical clam

harvesting boats be a fair judgment? Fishing boats are small, nautical, picturesque, and come and go in the field of view. On the other hand, the harvesters that have operated to date on Puget Sound are awkward-looking boats with unappealing and sometimes noisy hydraulic escalator equipment mounted on one side, plus they tend to remain in one area for several weeks. If the mechanical harvesters improved the visual appearance of their rigs or rotated their activities through different lease tracts more rapidly, would they, too, become part of a valued, diverse, visual environment?

Evaluation of noise levels need not be as subjective as the evaluation of visual amenities. The State of Washington has established noise pollution regulations based upon the level of noise in an area and the established use patterns of the area (WAC 173-60). Standard noise measurement techniques exist and compliance can be readily determined. Nevertheless, certain legal noise levels may still be irritating within specific natural settings because of their continuous nature or because weather conditions channel the noise toward a specific receiver and make the noises more noticeable than usual.

Noise emission from a device such as a mechanical clam harvester is, however, a problem which can be reduced by more efficiently muffling the noise at its source or restricting harvesting to daytime hours in order to avoid disturbing the sleep or relaxation of nearby residents. The cost to the harvester is the purchase price of muffling equipment and the loss of opportunity to harvest in the deeper sections of a plot during the very low tides which occur during the winter nights. If such mitigating actions were implemented, many noise problems could be eliminated. However, the question of who (the operator, the state, or the upland residents) should bear the costs of changes to mitigate aesthetic impacts, even those which meet legal standards, remains unanswered.

SETTING PRECEDENTS

In Washington State, most participants in aquaculture development and siting controversies are aware of the novel circumstances and of the precedent-setting aspect of decisions that are being made. If one harvester is permitted, would a fleet of mechanical clam harvesters develop in Puget Sound and destroy major clam resources? If five acres of mussel rafts are allowed in a bay, will the operation eventually expand to fill the entire bay? If an aquaculture project is prohibited by one county, would interested aquaculturists and food processors leave the state and take their jobs elsewhere? Or, would they simply take their operations to a cooperative neighboring county on the same embayment? In general, how will decisions made today affect decisions in the future?

Residents and upland landowners may fear massive expansion of aquaculture activities once a foothold is achieved. To gauge whether these

fears are well-grounded residents need to know (a) what are the realistic economic and biological potentials of growth for different kinds of aquaculture, (b) what are the risks at various levels of activity of cumulative damage to the environment, and (c) what are the appropriate governmental controls and the available methods for public involvement in future decision-making. Great vacuums of information surround these questions.

On the other hand the resource managers in WDF and DNR and the aquaculturists are concerned that local governments will continue to prohibit the siting and development of aquaculture activities without fully considering all state and local interests and concerns. A possible end result of such decisions is that no aquaculture would be permitted wherever upland residents protest. In that case, aquaculture as an industry could vanish from Washington's inland waters. The agencies and the industry express the need for (a) predictability and rationality in future aquaculture siting decisions, (b) public recognition of the environmental and operational constraints which limit the selection of suitable sites, (c) decisions which distinguish between use practices that create permanent environmental change and those which result in short-term disruptions, and (d) public acceptance of the legitimacy of aquacultural use of public resources.

Resource biologists in the Department of Game are concerned about another precedent-setting aspect of aquaculture siting issues. If mechanical clam harvesting becomes established and expands in importance, eelgrass or kelp may come to be regarded as "weeds" and natural predators on clams declared "pests". Measures may then be sought to chemically or physically remove these "weeds" and "pests". In mechanical clam harvesting the clam harvester itself could easily be used to control clam predators (e.g. moonsnails, starfish or drills). Analogous situations have developed in the oyster industry. Ghost shrimp and certain worms of the bottom community are regarded by oyster farmers as threatening and undesirable because they constantly burrow and tunnel through the sediment destroying the oyster beds. Ghost shrimp control programs have become necessary to protect the productivity of the oyster beds. Other animals, especially starfish and drills, are natural predators on the oysters. Some oyster farmers press for the chemical elimination of these organisms.

The future and long-term maintenance of environmental quality and of economically viable aquatic resource-based industry require a level of predictability which does not exist at present. The lack of predictability will be used to challenge the developing industry and without this same predictability, any new investment in aquaculture ventures will be discouraged. Without this predictability the dissatisfactions shown by all parties are not likely to be lessened.

Even if the information were available to evaluate all the above questions, other procedural difficulties still exist. Who should decide? How should decisions be made?

MAKING THE DECISION: MANY AGENCIES, OVERLAPPING RESPONSIBILITIES, LITTLE COORDINATION

Around the nation, government agencies at all levels have legal powers and responsibilities to plan for and to manage aquatic area uses, including aquaculture. (See Appendix B: The Legal Framework for Aquaculture Management.) When agency responsibilities overlap and the proposed uses present conflicts between agency policies, problems arise.

Living resources can be lost when government interests conflict or when there is little flexibility in agency programs. An extreme example occurred on the Semiahmoo Peninsula near the Canada-Washington border. A marina developer obtained from the county and Corps of Engineers the permits necessary to dredge a navigation channel across a privately owned tideflat. When WDF learned of the proposed development, Department shellfish experts recognized that a dense population of clams would be destroyed when the channel was dredged. Hand digging and sport clamming could not adequately harvest the population in the time allowed before the construction of the channel. Although WDF no longer allows intertidal mechanical clam harvesting, the agency decided a salvage operation was justifiable to harvest the clams along the channel dredging route. The developer and land owner agreed. WDF made arrangements to permit a mechanical clam harvester to work the area. However, the Corps of Engineers, operating under their regulations and directives, informed the developer and WDF that a permit modification would be required before mechanical clam harvesting to salvage the existing stock would be allowed. The three-month delay this modification would entail was economically unacceptable to the developer. The channel was dredged and the clam population was lost.

Difficulties in interagency coordination can arise when legislative mandates to the agencies overlap or conflict. For instance, both DNR and WDF are charged with management responsibilities for state-wide aquatic resources. The Washington State Department of Ecology (DOE), which manages the Shoreline Management Act (SMA) and approves county shoreline master programs, also makes decisions which affect these same resources. Both DNR and WDF are concerned that DOE is inadequately handling the questions of state-wide concern in the area of aquaculture development and siting. To address this problem DNR has requested assistance from DOE to help resolve the issue of who should have permitting authority for aquaculture siting: specific state agencies or the counties (17).

Understandably, differences in philosophies surface among resource management agencies which affect aquaculture policies. A primary concern of the Washington State Department of Game (WDG) is the protection of aquatic systems that support both game and non-game species. Both DNR and WDF share these concerns with WDG, but DNR and WDF also are charged with leasing public land and provising economic opportunities for fish

and shellfish industries. The interests of all of these agencies are not always compatible.

Overlapping powers and conflicting objectives can also result in agencies and governmental units becoming adversaries in litigation. Some county governments and the WDF and DNR are on opposite sides of the mechanical clam harvesting dispute. In the Kitsap County dispute over mechanical clam harvesting, the state agencies and an individual harvester have appealed a decision of the county commissioners to the Shoreline Hearing Board (SHB 78-37). The quasijudicial framework of the SHB provides a valuable political and legal forum for resolving conflicts. However, the adversary nature of these procedures can cause difficulties. The best decisions in a specific case (or cumulatively in a number of cases) may not result. A working situation of mutual good feelings useful for the objective and cooperative resolution of future problems may be difficult to maintain.

In September 1978 the Kitsap County Board of Commissioners denied a Substantial Development Permit that would have allowed a mechanical clam harvester to continue operating on state-owned subtidal clam beds in the Agate Passage area of Puget Sound. The Board of Commissioners concluded that the county had jurisdiction over clam harvesting in the area, that mechanical harvesting requires a Substantial Development Permit under the State Shoreline Management Act (RCW 90.58.140), and that the particular activity failed to comply with regulations in the Kitsap County Shoreline Master Program. The county's ruling was contrary to the advice and opinions of the WDF and the DNR. The operator, DNR and WDF are appealing the decision to the Shorelines Hearing Board (SHB 78-37). Regardless of SHB's decision, the losing party will probably appeal the case to the State Courts. A similar history surrounded the mechanical harvesting of intertidal soft shell clams in Port Susan Bay (18).

Based on these experiences and others, both DNR and WDF are concerned that some counties are anti-aquaculture and are trying to supersede the resource management authority of the state over state lands and state resources. As a result of these concerns, the state resource agencies unsuccessfully supported a bill in the 1979 State Legislature to remove from the realm of the Shoreline Management Act and from the control of county decision-makers "the culture and harvesting of aquatic plant or animal resources in tidal waters below the mean low tide, where the construction of permanent structures is not required" (19).

Similar conflicts may arise in the future around the question of whether the commercial harvesting of geoducks from subtidal state-owned beds requires a county-issued Substantial Development Permit under the Shoreline Management Act. The geoduck, Panope generosa, is one of the largest clams in the world. The harvest of geoducks in Puget Sound is also the largest clam industry on the west coast of North America. Operating permits are administered by WDF and the Corps of Engineers. DNR has additional regulatory functions through leasing of submerged areas for geoduck harvesting. Suitable sites for commercial geoduck harvesting

are located in a number of counties (20) besides those few which contain processing plants. WDF and DNR are concerned that counties which do not have an economic stake in geoduck processing might ban geoduck harvesting from their jurisdictions and in doing so negatively impact the economy of other counties.

USING LAND-USE PLANNING CONCEPTS IN AQUATIC AREAS

The management region defined in the Shoreline Management Act is the area from a line 200 feet landward of the mean high tide seaward to the limit of county geographic jurisdiction. The geographic extent of the aquatic area is usually greater than the land area included in these managed shorelines. The physical and biological characteristics of the aquatic regions are special and quite different from the adjoining land areas. Yet, most county shoreline management programs do not specifically plan for the aquatic areas or take into account the special properties or potential of aquatic areas. The counties have used their long-established experience in land-use planning to develop management plans for the shorelines. A few programs do specifically designate a separate aquatic area, but it is not differentiated into use or capability categories based upon aquatic characteristics.

Shore use categories are defined by existing and desired land uses: generally urban, rural, natural and conservancy. Aquatic area uses are expected to be compatible with these existing upland use designations. Sometimes overlooked is the fact that in aquatic areas a number of factors define the suitability of a site for a particular use such as aquaculture in addition to compatibility with upland uses.

For example, the number of areas where clams could be mechanically harvested is limited. Hard shell clams are not found everywhere. These clams require a firm bottom of coarse sediments (mixtures of coarse sand, gravel, and shell fragments); moderate to high velocity water currents (0.5 to 2.0 knots); and low intertidal to shallow subtidal water depths (maximum depths of 30 to 40 feet below mean lower low water).

In addition, the WDF has restricted mechanical clam harvesting to beds which meet specific criteria in order to reduce the risks of environmental damage (21). To meet the standards for preventing undesirable changes in water turbidity and water quality, sediments in mechanically harvestable clam beds must contain less than 15% clay and silt, and greater than 10% coarse sand, gravel and shell material. Also, for a clam bed to be leased for harvest, the chemical composition of the sediment must be within the limits set by the Environmental Protection Agency (22) for decaying organic materials (sulfides and volatile solids) and must contain less than a specified amount of nutrients (nitrates and phosphates). To avoid damage to eelgrass and the organisms dependent upon eelgrass habitats, WDF further restricts harvesting to areas of

sparse eelgrass vegetation (less than 13 leaf clusters per 1/4 square meter in the summer). WDF also prohibits mechanical harvesting on sites where there is a reasonable probability that harvesting would have important adverse impacts on the Dungeness crab, herring, kelp or any other significant species.

Operating restrictions on the harvesting apparatus itself further limit harvesting. The hydraulic harvester requires shallow depths, areas with few boulders and some protection from high waves and winds. In order for mechanical harvesting to be economically feasible, the density of clams in a bed must be greater than 1/4 pound per square foot.

Clam beds which meet the harvester's technical needs and which fulfill WDF's environmental criteria can be unsuitable for other reasons. Possible interference with navigation eliminates aquaculture from navigation lanes and harbor areas. Contamination of water due to domestic or industrial pollutants prevents harvesting for human consumption from such waters. Other beds cannot be harvested because to do so would conflict with sport or commercial harvesting of crabs, geoducks, or other organisms.

In the inland waters of Western Washington, WDF surveys show only 22 sites where there are commercially sized hard shell clam beds (23). Only part or all of nine of these beds in the entire Puget Sound and adjoining aquatic areas are suitable for mechanical clam harvesting according to the above criteria (24).

County land-use planning perspectives approach the question of site suitability for mechanical clam harvesting from an upland perspective. The site of one conflict -- Agate Passage in Kitsap County -- is designated as a semi-rural environment. A semi-rural environment is defined in the Kitsap County Shorelines Master Program as an area in which the predominant features are modified by the action of man but which still maintain significant natural features. The County Master Program states further that a multiplicity of human uses is to be insured in such areas. Residences and recreational property characterize the shoreline. In the Kitsap County - Agate Passage case, oral and written testimony before the County Board of Commissioners claimed that mechanical clam harvesting in the aquatic area is incompatible with upland land use in the area (25). If mechanical clam harvesting in the other eight clam beds in Puget Sound which are capable of being harvested is also objectionable to upland residents, mechanical clam harvesting could be entirely eliminated from the Sound.

Similar situations could develop for other aquacultural uses (e.g., mussel rafting, oyster farming, or salmon rearing) because suitable sites for such projects are also limited.

Site suitability for mechanical clam harvesting, or any other aquaculture activity, is limited by both aquatic and land constraints. Yet in most county and state plans, the problems of land use/aquatic use compatibility or suitability are left undefined and are, therefore, open to

varying interpretations by upland residents, county commissioners, state resource agencies,and state or county coastal zone planners.

ADDRESSING MANAGEMENT NEEDS

Government programs to address the aquacultural use of aquatic areas are developing. A Federal Joint Interagency Subcommittee on Aquaculture has begun a study of the federal and state regulations impacting the development of the aquaculture industry. The National Academy of Sciences has identified a number of the obstacles to and opportunities for commercial aquaculture (26). In Washington, state resource agencies and university researchers are conducting specific studies of problems important to aquaculture including biological surveys of hard shell clam and geoduck populations, site suitability studies for larval mussel setting, and culturing techniques for oysters, clams, and algae (27).

The management needs of aquaculture siting and development decisions are multidimensional. Complex questions exist which require technological, environmental, social, economic and jurisdictional inputs for satisfactory answers. With this in mind, several new activities in Washington show special potential.

At the direction of the Washington State Legislature, the Oceanographic Commission of Washington (OCW) will direct the Oceanographic Institute of Washington (OIW) to examine the state clam and mussel industries. The OCW is currently scoping study approaches. Possible topics for study include an examination of the technological, jurisdictional, and economic obstacles facing these industries, the identification of technological and economic innovations which could be utilized to overcome these obstacles, and an exploration of legislative avenues which could allow the industry to prosper and to co-exist with other coastal uses.

Three counties in northern Puget Sound (Island, Snohomish, and Skagit) are considering initiating a regional aquaculture project. Funded through the Washington Department of Ecology (DOE), the goal of the project would be to develop a regional aquaculture plan for the waters between the three counties. Specific activities of the project will be to (1) analyze the aquaculture potential of northern Puget Sound and identify what types of aquaculture are feasible in the aquatic systems of the region, (2) analyze and identify environmentally and socially suitable areas for aquaculture, and (3) integrate the aquaculture plan into local shoreline master programs. County planning staffs will manage the project with the help of local citizens' committees and the technical expertise of state and federal resource agencies and the Washington Sea Grant Program (28).

Another project of the DOE's coastal zone management program is a regional oyster culture project. The problems to be addressed by this

project are the negative impacts that upland development can have on the viability of intertidal oyster beds. The project will be designed to identify impacted oyster beds and their associated drainages, identify those upland activities which affect the quality of the oyster beds, determine institutional and technical alternatives, and propose solutions (29).

The State Department of Ecology is also coordinating an effort involving state and federal agencies which is intended to coordinate aquatic management policy. The product of this effort, hopefully, would provide specific guidance to local shorelines administrators on aquatic area use policy.

The significance of aquaculture as a renewable, resource-based industry and as a source of food argues strongly for the need to resolve present siting controversies and to provide a mechanism to deal with future decisions.

Regardless of the approach pursued, the equitable and wise use of public aquatic areas and resources demand public attention to the substantive problems of:

- determining the public interest in aquaculture,
- the nature of siting precedents,
- the risks and importance of changes in aesthetic qualities of shorelines, and
- the risks and importance of ecological damage to coastal resources;

and to the procedural problems of:

- the preoccupation with land uses and inadequate treatment of aquatic area uses, characteristics and potential, and
- the overlapping jurisdictions and responsibilities of federal and state resource management agencies and local governments.

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(23) Washington Department of Fisheries Technical and Progress Reports (See No. 10). Lynn Goodwin, personal communication.

(24) Ibid. and Washington Department of Fisheries/Department of Natural Resources. Final EIS (See No. 12).

(25) Kitsap County Board of Commissioners' Findings of Fact and Conclusions of Law Supporting Denial of Substantial Development Permit Application No. 225. October 10, 1978.

(26) National Academy of Sciences. 1978. Aquaculture in the United States: Constraints and Opportunities. Report to the Committee on Aquaculture, Nutrition and Forestry of the U.S. Senate.

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APPENDIX A

LEGAL FRAMEWORK FOR AQUACULTURE MANAGEMENT

Aquaculture activities are concentrated in those marine areas seaward of the extreme low water line. The Washington Shoreline Management Act of 1971 (RCW 90.58) provides the basic framework for the regulation of use of subtidal areas. The Legislature defined these, along with other areas, as areas of state-wide significance and gave priority to uses which, in order of preference, (1) recognize and protect the state-wide interest over solely local interest, (2) preserve the natural character of the shoreline, (3) result in long-term over short-term benefit, (4) protect the resources and ecology of the shoreline, and (5) increase public access to and recreational opportunities for the publicly-owned shoreline areas.

Under the Shoreline Management Act (SMA), planning and management of the shorelines in Washington State are primarily the responsibility of local governments. Policies established by the Legislature and guidelines formulated by the Washington State Department of Ecology (DOE) guide the local planning and management decisions. The SMA requires counties and incorporated towns and cities to develop shoreline master programs and to regulate shoreline use through a permit system. All Washington counties have fulfilled this requirement and have state-approved Shoreline Master Programs. The DOE can appeal permit decisions. Local challenges to DOE decisions are then reviewed by a quasijudicial Shorelines Hearing Board (SHB).

Local governments do not, however, have the legal authority to entirely control the use of the coastal area within their jurisdiction. Legally the coastal area is a complex mix of federal, state, and local proprietary and regulatory rights and responsibilities.

The shoreline land area and wetlands may be in either private or public ownership, but the beds seaward from the line of extreme low tide plus associated mineral and living resources remain in state ownership (with the exception of some federal property). Although these subtidal areas are within the geographic jurisdiction of the counties, the Washington State Department of Natural Resources (DNR) is responsible for administering and leasing these state-owned subtidal beds and their resources (RCW 79.01). The DNR has developed an allocation plan similar to county zoning or land use plans which outlines the range of permissible uses in state-owned subtidal areas. The DNR administers a lease program in accordance with this plan. Two basic concepts guide DNR allocation decisions: multiple use and recognition of the public trust. The multiple use concept attempts to avoid permanent, single-purpose uses in areas that have multiple use potential. The public trust concept provides for compensation to the public for restriction or withdrawal of uses from the public, for returns to the public in food and money from the cultivation

and harvesting of aquatic resources and for the protection of the biological productivity of natural ecosystems. The DNR Allocation Plan treats aquaculture in a general way. In order to define appropriate aquaculture sites, the DNR identifies certain criteria. To protect the rights of upland owners and users of the shore and water surface, sufficient water depth and distance from the shore area are necessary. Specific wave and tidal current conditions are required to protect structures and activities associated with aquaculture. Furthermore, the aquaculture activity must be compatible with other uses.

The second state agency with an important role to play in aquaculture management is the Washington State Department of Fisheries (WDF). WDF has the responsibility for management and protection of food fish and shell fish (RCW 75.16). WDF expertise focuses on the development of the information necessary to provide for the maintenance of the economic viability of commercial resource harvesting and aquaculture and, at the same time, to protect and conserve natural resources. WDF is empowered to establish regulations, enact licensing and permitting programs, and enforce state fisheries laws (RCW 75.08, 75.28, and 79.01).

State agencies with additional roles include the Department of Game, which has responsibility for management and protection of sport and nongame organisms (RCW 77.08); the Department of Social and Health Services, which has the authority to certify harvesting and aquaculture areas in compliance with health standards (RCW 69.30); and the Department of Ecology, which has general responsibility for assuring the protection of environmental quality (WAC 187.10).

State agencies are, however, subject to certain federal and local powers.

Reserved to the federal government by the U.S. Constitution are the powers to regulate all activities affecting interstate and foreign commerce. Activities regulated and administered by the federal government are navigation (Coast Guard); dredging, filling and dredge disposal (Army Corps of Engineers); and environmental quality (Environmental Protection Agency). The Corps has recently begun to exercise considerable influence on aquaculture siting through its permit system. The permit program is based on Sec. 404 of the Federal Water Pollution Control Act Amendments of 1972, and Sec. 10 of the Rivers and Harbors Act of 1899.

Local governments have been delegated powers from the state government for land use planning and zoning. Local government Shoreline Master Programs provide the mechanism for local planning and zoning for uses of aquatic areas. Although the state retains regulatory power over state-owned subtidal beds and resources, state agencies (e.g., DNR and its lessees) must obtain Substantial Development Permits from local governments for uses of coastal aquatic areas subject to the Shorelines Management Act.

Thus, the circle of aquatic area powers and regulations returns to the Shoreline Management Act. Department of Ecology guidelines for the treatment of aquaculture in the Shoreline Management Programs are:

(a) aquaculture enterprises should not interfere with navigational accesses of upland owners, nor significantly restrict commercial traffic;

(b) possible detrimental impact of aquacultural development on the visual access of upland owners and on the general aesthetic quality of the area should be recognized; and

(c) emphasis should be placed on the development and use of underwater structures which do not interfere with navigation or impair the aesthetic quality of Washington Shorelines. (WAC 173-16-066-2).

APPENDIX B

MECHANICAL CLAM HARVESTING

In the early 1950s Fletcher Hanks invented the hydraulic escalator clam harvester in an attempt to salvage Maryland's declining soft shell clam industry. Harvest from the rich sand banks and mud flats had been decreasing because hand diggers were taking jobs elsewhere that did not require working for minimal wages in the cold, the wet, and the dark. Operation of the mechanical clam harvester gave a new vitality to the commercial harvest of soft shell clams.

In the late 1950s a Washington fisherman with the financial support of a local cannery brought the Hanks harvester to Puget Sound. After modifications to the apparatus, which were necessary for operation in gravelly bottoms, the mechanical harvester supplied large quantities of high quality butter clams to a receptive market. But leasing and permitting entanglements slowly eliminated incentives. The fisherman sold out and returned to salmon fishing. Over the years others have entered and left the Washington mechanical clam harvesting industry. In the early 1970s at the peak of the activity, six mechanical clam harvesters operated in the inland waters of western Washington and provided about one-half of the total commercial clam harvest in the state. In 1979 there is only one mechanical clam harvester (and its future is in question) and the subtidal mechanical harvest of clams has dropped to less than one-third of the total clam harvest.

The harvesters are small vessels to which a harvesting arm has been mounted on the side. The harvesting arm is a hydraulic escalator which consists of a bank of water jets placed in front of a steel mesh conveyor belt. As water jets loosen the sediment, clams and other organisms are washed onto the moving belt and are carried to the surface where the boat crew picks out the clams. Undesired material remains on the conveyor belt and drops off its end back into the water. Instead of plowing through the sediment, the mechanical harvester advances only as fast as the eroding sediment permits it to move (usually less than 900 feet/hour). The hydraulic head of the harvester is about three feet across and the depth of its cut is regulated to between 12 and 18 inches. The length of the escalator arm limits the operation to water depths less than about 20 feet.

The mechanical clam harvester can cover considerably more ground per unit of time than a hand digger, is much more efficient in terms of catch per unit effort, creates far less shell breakage than hand digging, and can harvest clams from subtidal depths which are inaccessible to the hand digger. However, the initial capital outlay for a vessel, harvesting gear, and lease right to the clam beds is usually quite large and the operating costs are substantial. Therefore, a high density of clams in the beds and lengthy period of operation in a bed are necessary for the

mechanical clam harvesting operation to be profitable. The Washington State Department of Fisheries estimates that a density of about one-quarter pound of clams per square foot is necessary for the operators to make a profit.

Harvestable clam species can be divided into two broad categories: hard shell clams and soft shell clams. Important differences in shell fragility, in preferred habitat, and in physiology affect clam harvesting operations and the environmental impact of the operations. The soft shell clam, Mya arenaria, is harvested extensively on the East Coast of the United States, but has been a less important target species on the West Coast. The light, brittle shell of Mya arenaria and the inability of the adults to maintain themselves in sediment which is constantly shifting due to water currents and waves limits this species to the calm inter- and subtidal mud flats of protected bays where they thrive under brackish water conditions. The major species of clams harvested in Puget Sound are members of the hard shell group: butter clams (Saxidomus giganteus), native and Japanese littleneck clams (Prototheca staminea and Venerupis japonica) and gapers or horse clams (Tresus capax and Tresus nuttalli). Unlike the soft shell clams, the habitat requirements of these hard shell clams are for moderate-to-strong tidal currents and coarse sand and gravel sediments. Sexually mature hard shell clams (three to five years) spawn in the summer months but may not reproduce regularly every year. The planktonic larvae are dispersed by the currents and individuals of particular inter- and subtidal clam beds are often recruited from distant beds. Although poorly understood by biologists, the free-floating larval clams are able to select appropriate bottom types based on sediment particle size, chemical composition and firmness. The larvae settle and begin to slow development into sessile adult clams. Good general descriptions of the animals and their habitats can be found in:

Quayle, D.B. 1960. The Intertidal Bivalves of British Columbia, B.C. Provincial Museum. Department of Education. Handbook No. 17.

In Puget Sound extensive hard shell clam beds which are commercially harvestable are few and unevenly distributed. Not only must the habitat be suitable to support commercial densities of clams, but also the water must be unpolluted by domestic and industrial sewage. Additionally, the mechanical harvester can only operate in areas protected from storm waves and strong winds, on bottoms relatively free of boulders and of eelgrass, and at depths limited by the length of the harvesting arm of the vessel.